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(54) Title: OPERATING MECHANISM		
(57) Abstract		
A mechanism for displacing at least one actuating member (22, 23) in a direction in response to displacement of an operating member (15) in said direction, the mechanism including four elements (24-27) pivotally connected to one another generally in the form of a rhombus, with a pivotal connection (28) between a first two of the elements being displaced by the operating member and the pivotal connection (31) between the other two of the elements being held stationary, the at least one actuating member (22, 23) being engaged by at least one (26, 27) of said elements between the ends thereof. The mechanism is applicable to push-button operated electrical switches.	<p>The diagram illustrates a mechanical linkage mechanism. It features a central vertical column with a rectangular base. Four arms (24, 25, 26, 27) are hinged to this column at their upper ends. Arm 24 is positioned vertically below arm 25. Arms 26 and 27 are hinged to each other at their lower ends. A horizontal actuating member (22, 23) is shown being moved downwards, which causes arm 27 to rotate clockwise. This rotation is transmitted through a series of linkages (11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31) to move another part of the mechanism (e.g., 10, 31). The number -20- is printed near the bottom center of the diagram, and -21- is printed near the bottom right.</p>	

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Title: OPERATING MECHANISM**Description of Invention**

This invention relates to an operating mechanism, for effecting displacement of a member (herein called an actuating member) in a direction in response to a displacement of a further member (herein called an operating member) in that direction.

The invention has been devised in relation to push-button operated electrical switches. There are many situations in which push-button operation of electrical switches is required, and in some situations a single push-button may be required to operate several sets of contacts in a single switching unit or a number of switching units assembled in relation to one another so as to be operable from a single push-button. If one or more of such switches are of heavy-duty type, the force required to be exerted by an operator on the push-button may be substantial: such switches characteristically include strong springs to resist movement of their operating members. If switch operation is required frequently, the requirement for an operator repeatedly to press a push button against a strong spring force is potentially hazardous in terms of repetitive strain injury to the operator.

If it is well known that a simple lever arrangement can be utilised to provide a mechanical advantage between an actuating member of an electrical switch and an operator's push-button, but this is a bulky arrangement and not readily accommodated in, for example, a control panel incorporating a large number of push-button operated switches adjacent one another.

Accordingly, there is a requirement for an operating mechanism by which a mechanical advantage can be established between an actuating member of a switch and an operator's push-button, but which is simple and compact. It is the object of the present invention to meet, as far as possible, this requirement.

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According to the present invention, we provide a mechanism for displacing at least one actuating member in a direction in response to displacement of an operating member in said direction, said mechanism including four elements pivotally connected to one another generally in the form of a rhombus, with the pivotal connection between a first two of said elements being arranged to be displaced in said direction by said operating member, the pivotal connection between the other two of said elements being held stationary, and said at least one actuating member being engaged by at least one of said elements between the ends thereof. Preferably there are two actuating members which are engaged by said other two of said pivotally-connected elements between the ends of said elements.

In a mechanism in accordance with the invention, the arrangement of the four elements in the configuration of a rhombus is such that displacement of the operating member results in a flattening of the rhombus and hence pivotal movement of said other two elements about the point of their pivotal connection to one another which is held stationary. A given displacement of the or each actuating member engaged by one or both of said other two elements requires a much greater displacement of the pivotal connection between the first two of said elements and hence of the operating member which engages said connection. The ratio of the magnitude of such displacements, of course, depends on the exact geometry of the mechanism.

Preferably the operating member comprises or is directly operable by an operator's push-button.

These and other features of the invention will now be described by way of example with reference to the accompanying drawings, of which:-

Figure 1 illustrates the invention in a first operative position, and

Figure 2 illustrates it in a second operative position.

Referring to the drawings, the face of a control panel is indicated at 10 and there is mounted therein a push-button unit indicated generally at 11. The

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push-button unit 11 has a bezel 12 and a body 13 which extends through an aperture in the control panel and is somewhat cup-shaped, having a rear portion 14. A push-button having a stem 15 and head 16 is mounted within the body 13, the stem 15 slidably passing through an aperture 17 in the rear part 14 of the body. At its free end, where it protrudes beyond the aperture 17, the stem 15 is fitted with a retaining washer 18, e.g. retained by a circlip.

Beneath the push-button unit 11 and connected thereto by a carrying member indicated generally at 19 there are disposed two electrical switches or contactor units 20, 21. Each of these is of a type having two pairs of contacts, the respective pairs of contacts of the contactor unit 20 being operable by actuating members 22, 23 respectively. The contacts may be normally open or normally closed, or there may be one set of contacts of each type, and they are brought to the respective other condition (open or closed) by depression of the respective actuating members 22, 23. The contactor unit 21 has similar actuating members not shown which protrude into the contactor unit 20 and are also displaced when the actuating members 22, 23 are displaced.

Interposed between the end of the stem 15 and the actuating members 22, 23 there is a mechanism including four elongate elements 24, 25, 26, 27 pivotally connected to one another at 28, 29, 30, 31. The pivotal connection 28 between the elements 24, 25 abuts the end of the stem 15, whilst the pivotal connection 31 between the other two elements 26, 27 is held stationary relative to the connecting member 19. The pivotal connections 29, 30 between the elements 24, 26 and 25, 27 respectively are free to move within the connecting element 19. The connection 28 between the elements 24, 25 is guided for linear movement relative to the carrying member 19, e.g. by having a hinge pin whose opposite ends engage in respective slots in opposed sides of the carrying members.

The actuating members 22, 23 abut the elements 26, 27 between the ends thereof.

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The elements 24 to 27 are thus pivotally connected to one another generally in the configuration of a rhombus, and when the push-button 15, 16 is depressed the rhombus is flattened as shown in Figure 2 of the drawings. It will be appreciated from a consideration of Figure 2 that a substantial displacement of the push-button 15, 16 has resulted in a proportionate but lesser displacement of the actuating members 22, 23, with the ratio between such displacements dependent on the exact geometry of the arrangement of the elements 24, 27 and, particularly, where the actuating members 22, 23 engage the elements 26, 27. In any event, a substantial mechanical advantage is established, so that considerably less force has to be exerted by the operator on the push-button 15, 16 than the force which would be required to be exerted if the actuating members 22, 23 were engaged directly by the end of the stem 15.

Since in a practical installation several contactor units as 20, 21 may be connected beneath one another for operation by a single push-button, and since a considerable force might then be required to be exerted particularly if they are heavy duty units, the invention provides a particularly neat and compact arrangement by which the force required to be exerted by an operator can be reduced.

The elements 24 to 27 may be individual rigid elements, e.g. of sheet metal or an appropriate plastics material, pivotally connected by appropriate hinge arrangements at 28 to 31. An alternative possibility is that such elements of an appropriate plastics material may be pivotally connected by "living hinge" arrangements, i.e. portions wherein the cross-sectional dimension of the material is sufficiently small to pivotally connect the elements to one another by flexing of the material. It is envisaged that an assembly of such elements might be manufactured as a flat strip of the elements in line with one another, with three integral "living hinge" formations therebetween, the outermost ends of the end elements being provided with formations enabling them to be

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pivots connected together after the strip of elements has been bent into the rhombus configuration.

The features disclosed in the foregoing description, or the accompanying drawing, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

1. A strip of elements, each element having a central portion and a pair of side portions, the side portions being pivotally connected to the central portion, the strip being bendable into a rhombus configuration.

2. The strip of claim 1, wherein the side portions are pivotally connected to the central portion at a point located substantially in the middle of the side portions.

3. The strip of claim 1, wherein the side portions are pivotally connected to the central portion at a point located substantially at the outer ends of the side portions.

4. The strip of claim 1, wherein the side portions are pivotally connected to the central portion at a point located substantially in the middle of the side portions.

5. The strip of claim 1, wherein the side portions are pivotally connected to the central portion at a point located substantially at the outer ends of the side portions.

6. The strip of claim 1, wherein the side portions are pivotally connected to the central portion at a point located substantially in the middle of the side portions.

7. The strip of claim 1, wherein the side portions are pivotally connected to the central portion at a point located substantially at the outer ends of the side portions.

8. The strip of claim 1, wherein the side portions are pivotally connected to the central portion at a point located substantially in the middle of the side portions.

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CLAIMS:-

1. A mechanism for displacing at least one actuating member in a direction in response to displacement of an operating member in said direction, said mechanism including four elements pivotally connected to one another generally in the form of a rhombus, with a pivotal connection between a first two of said elements being arranged to be displaced in said direction by said operating member, the pivotal connection between the other two of said elements being held stationary, and said at least one actuating member being engaged by at least one of said elements between the ends thereof.
2. A mechanism according to Claim 1 comprising two actuating members engaged by said other two of said elements.
3. A mechanism according to Claim 1 or Claim 2 wherein the operating member comprises or is directly operable by an operator's push-button.
4. A mechanism according to any one of the preceding claims wherein said four elements comprise separate components, pivotally connected by hinge means.
5. A mechanism according to any one of Claims 1 to 3 wherein at least two of said four elements comprise plastics components integrally connected to one another by "living hinge" formations.
6. An electrical switch assembly comprising switching means having at least one actuating member and a mechanism according to any one of the preceding claims for displacing said at least one actuating member.

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7. A mechanism, or a switch assembly incorporating same, substantially as hereinbefore described with reference to the accompanying drawings.

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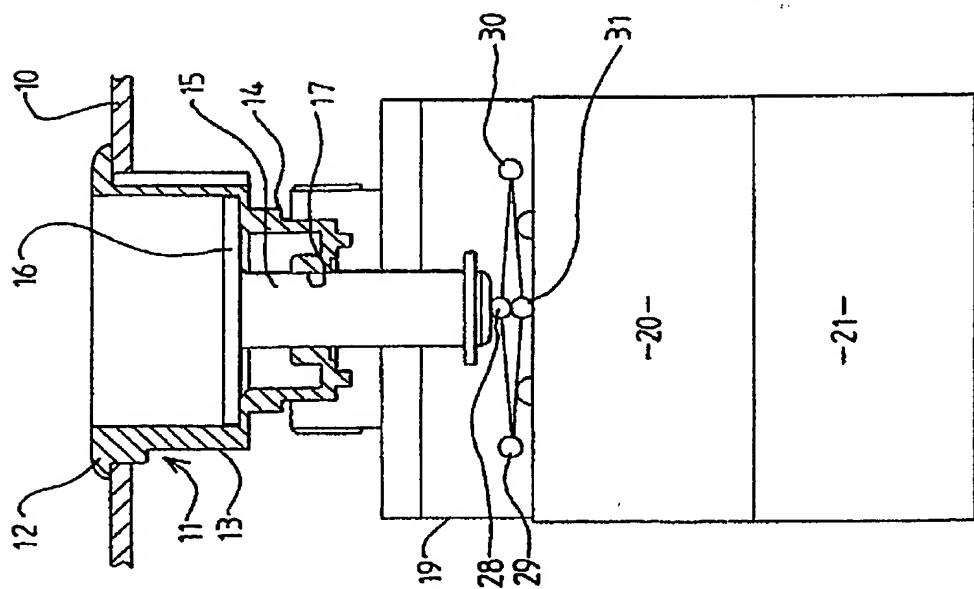


FIG 2

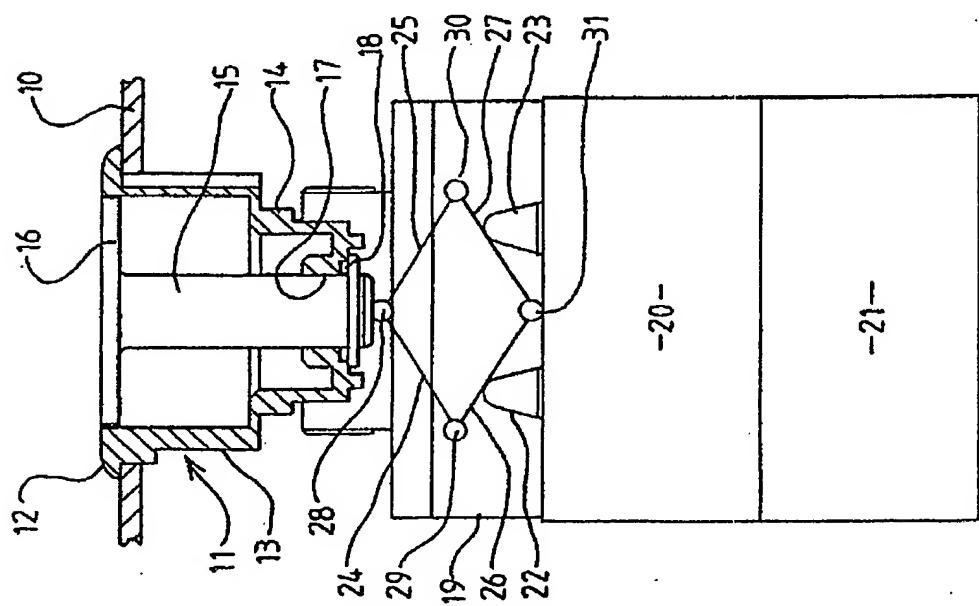


FIG 1

INTERNATIONAL SEARCH REPORT

International Application No PC., GB 99/02565
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A. CLASSIFICATION OF SUBJECT MATTER IPC 7 H01H13/20 H01H3/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT
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Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 562 203 A (MOCHIZUKI ISAO) 8 October 1996 (1996-10-08) abstract; figure 1	1

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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Information on patent family members

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PCT/GB 99/02565

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5562203 A	08-10-1996	JP 8124453 A	17-05-1996

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